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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re: New US Patent Application corresponding to
International Application PCT/DE99/03699
Filed November 19, 1999
Applicant Daniel Gens
Title APPARATUS AND METHOD FOR RECORDING DATA WHICH
CORRESPOND TO AN ITEM OF WRITTEN OR DRAWN INFORMATION
Attorney Docket (H) 99DGE1538USP

Box PCT
Commissioner for Patents
Washington, DC 20231

Preliminary Amendment

Dear Sir or Madam:

Please amend the above-identified application as follows:

In the Claims:

Claim 4, line 1, after "according to" cancel "one of Claims 1 to 3" and insert

--Claim 1--.

Claim 6, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

Claim 7, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

Claim 8, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

Claim 9, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

Claim 10, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

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Claim 11, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

Claim 12, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

Claim 13, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

Claim 14, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

Claim 15, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

Claim 19, line 1, after "Claim 17" cancel "or 18".

Claim 20, lines 1 and 2, after "according to" cancel "one of the preceding claims"
and insert --Claim 1--.

Claim 23, line 1, after "Claim 21" cancel "or 22".

Claim 24, line 1, after "according to" cancel "one of Claims 21 to 23" and insert
--Claim 21--.

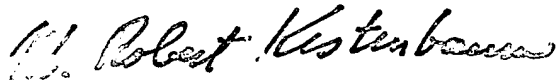
Remarks

This Preliminary Amendment cancels multiple dependencies in the claims.

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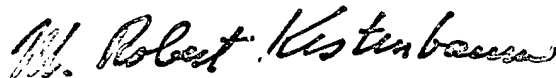
Please calculate the filing fee according to this Preliminary Amendment.

Respectfully submitted,



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Gens, Daniel

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5 Apparatus and method for recording data which
correspond to an item of written or drawn information

The invention relates to an apparatus in accordance with Claims 1 and 17, and to a method according to Claim 21.

10 Written information, that is to say documents, notes, drawings and pictures, for example, can be represented in the most varied forms. A very common form is the use of a pen as writing instrument and of a sheet of paper as writing pad. This produces an image
15 through direct reproduction on the sheet of paper, for example by means of ink or ballpoint paste.

So-called notepads have come onto the market recently. These function as a mobile, electronic notebook. In this case, the pen is guided over a smooth
20 surface, essentially by using LCD technology. Touching of the smooth surface is recorded electronically, and an image of the movements of the writing instrument over the smooth surface is produced. This image is evaluated, put through a character recognition process
25 and subsequently displayed on an assigned screen.

The image produced on the smooth surface with the writing instrument is available exclusively in the form of two-dimensional data. In the case of notepads, writing on normal paper while simultaneously recording
30 the written two-dimensional data in the form of signals is excluded. Notepads also do not provide the possibility of directly reading out what has been written on the surface to be written on; rather, the text written down is represented on a display. However,
35 such notepads require an uninterrupted power supply.

In addition, apparatuses are also known which serve the purpose of verifying a signature. Thus, European patent EP 0 276 109 B1 protects an apparatus and a method for recording drawings and written text.

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Both the position of a recording stylus, used in the process, on a writing pad, and a written text are determined by measuring an intensity of reflected or transmitted optical radiation. A text can be stored as an intensity signal. If, when a signature is being taken, the lighting conditions deviate from those under which the reference signature was taken, it is no longer possible to carry out reliable verification.

Document WO 99/22338 discloses an electronic recording stylus which uses acceleration sensors to convert the movements made during a writing operation into an electric signal. This electric signal, which can be represented on a display or can be stored, represents the written text.

A further apparatus, of the type of a recording stylus, for recording figures or written text for relaying to a data processing system is disclosed in US patent 5,902,968. Three acceleration sensors detect the movement of the apparatus as a text is being written in three spatial directions. Three gyroscopes pick up angular speeds about the three space axes in the process. A numerical unit calculates the inclination of the apparatus as a writing operation is started. With the inclination of the stylus, the acceleration picked up with reference to the stylus coordinate system is transferred into the coordinate system, given essentially by gravitational force, in which a writing pad is located.

The use of three gyroscopes signifies disadvantageous bulk in this case. Moreover, the absence of checking of the absolute stylus position during the writing operation is particularly disadvantageous.

It is therefore the object of the invention to provide an apparatus for applying an item of information to a writing pad or drawing pad, and simultaneously recording this item of information as a data record which is capable of accurately identifying

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the position of a recording stylus on the writing or drawing pad during the writing operation.

The features of Claims 1, 17 and 21 serve to achieve this object.

5 The invention is attended by the advantage that the information is present both in analog form on the writing pad and as a data record which can be stored. A particular advantage of the invention resides in the fact that it is possible to interrupt recording the
10 information on the writing pad without the data record thereby being rendered unusable. A further advantage resides in the fact that the apparatus according to the invention, or the method according to the invention operates using an electrically passive writing pad.

15 According to the invention, it is ensured that relative positions which are obtained from the movement of the writing instrument are corrected at discrete temporal and/or spatial intervals by determining the absolute position of the writing instrument with
20 reference to the writing pad. Consequently, according to the invention a coordinate system assigned to the writing instrument is adjusted to the coordinate system of the writing pad. The measured acceleration of the writing instrument is determined uniquely relative to
25 gravity. According to the invention, three translatory and three rotary movements are respectively determined.

A determination of the relative positions is performed in shorter time intervals than the determination of the absolute positions. In this case,
30 the first means determine the relative positions from the three-dimensional movement profile of the writing instrument, and the second means are designed as a marking on the writing pad and as an associated read-out unit in the writing instrument. The relative
35 positions are adjusted in each case given the presence of absolute positions.

Advantageous developments are specified in the subclaims.

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The writing pad can advantageously be coded, for example by an identifier applied to the paper. In this case, the identifier can be implemented in the form of a bar code, preferably in the form of an optically readable bar code, or as a magnetic layer. It is thereby possible for the position of the writing instrument on the writing pad to be fixed in a form of representation suitable for computers. Further data can be recorded by the writing instrument particularly easily in this way.

In one embodiment of the invention, the writing pad comprises a magnetic layer. Different points on the writing pad have different degrees of magnetization, and thereby different magnetic field strengths. As a result, a simple and cost effective solution is proposed for detecting different points on the writing pad.

Furthermore, the writing pad can have a linear or non-linear magnetic array by virtue of magnetic fields of different strengths. The writing pad is therefore divided into various regions. As a result of the magnetic array, the region of the writing pad currently being written in is detected. The array can result from magnetizing lines which separate the fields from one another. If the writing instrument is guided over a specifically magnetized region, the induction effect on the coil records when a field is transgressed.

In order to produce a conventional image on the writing pad, a substance is applied to the writing pad which adheres permanently to the writing pad, or penetrates more or less into the writing pad. That is to say, the writing instrument according to the invention has a conventional refill cartridge which releases a substance onto the writing pad.

In a further embodiment according to the invention, conventional paper is used as writing pad. Given the presence of a priori knowledge, it is possible to dispense with a determination of absolute

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position, thereby permitting the use of conventional paper. Advantages in cost, in particular, result therefrom.

Another embodiment provides the writing pad
5 with at least one optically detectable layer which is detected by the optoelectronic receiver on the writing instrument, and can contain information of various sorts. The optically detectable layer preferably varies from site to site, for example in the form of different
10 colours.

Furthermore, the invention can comprise a transmitter, with the result that the data obtained from the image on the writing pad can be transmitted to further devices directly or after buffering. A receiver
15 is correspondingly provided. This receiver can occur in the most varied designs, and there can be any distance between the transmitter on the writing instrument and the receiver.

Likewise, the data transmitted can be stored on
20 sides of the receiver. The recorded data can therefore be further processed in computers and inserted into existing databases without further operating steps and, as it were, without time delays.

Furthermore, in further embodiments according
25 to the invention, in addition to the two-dimensional data described above it is also possible to record further data on the writing pad - the pressure, the inclination, the speed and the acceleration with which the writing instrument is guided over the writing pad
30 during the writing operation. These data can be realized with particular cost effectiveness and ease with the aid of a sensor device, a trackball on the tip of the writing instrument and a piezoelectric transducer in the writing instrument. These data can be
35 used to recognize the user of the writing instrument reliably by comparison with the corresponding existing data.

A receiver can be attached to the writing instrument. This receiver essentially serves the

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purpose of receiving data as the reaction to the data sent by the writing instrument, thereby creating a bidirectional communication system.

5 In order advantageously to be able to process the recorded data further and render them useful, interfaces can be provided to the computers and databases.

10 A particular embodiment for storage independent of static computers, can, in addition to storage in the writing instrument itself, take place in many conceivable portable devices after the data have been transmitted to the respective device.

15 In the case of mobile use, the recorded two-dimensional data can therefore be stored, for example, in memories of a watch or a mobile radio set, thus rendering the apparatus according to the invention very much more flexible in use.

20 For security reasons, an identification number and/or a password can even be allocated to a user of the writing instrument or the writing instrument. Thus, for example, a writing operation can be detected as unauthorized if the identification number and/or password is not input correctly, it being possible for the inputting to be performed manually at the writing instrument, or else be written down and picked up and checked by the recording according to the invention.

25 Expediently, a signalling device which supplies an answer back for various uses can be attached to the writing instrument. The signalling device is essentially driven after processing of the data in the computer, during which any possible errors can be detected, and subsequent transmission of the error message to the writing instrument.

30 In a particularly advantageous way, the writing instrument can comprise a buffer for the data recorded. It is thereby possible to make further use even of data which are not directly transmitted to the transmitter.

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The invention is explained below in more detail with the aid of two exemplary embodiments, in conjunction with the accompanying drawings, in which:

Figure 1 shows a paper, which has a magnetic array, together with the writing instrument according to the invention and a receiver; and

Figure 2 shows a diagrammatic illustration of a second embodiment of a writing instrument according to the invention, in a partially broken open illustration.

Figure 1 shows a special paper 10 which has been provided with magnetizing material during its production process. In this special case, the paper is divided into various regions which have different degrees of magnetization and thus have a magnetic field which is to be defined in each case. The various regions preferably form a non-linear array 20. The magnetic fields 25 can, furthermore, correspond to fields and writing which is printed onto the magnetic paper in the usual way. As a result, a conventional printed form is assigned, in a manner resembling the practice of standard forms, to the fields 25 of different magnetic field strengths.

The fields 25 can be, for example, boxes or fields which are to be crossed or marked and in which written data such as, for example, name and address, are to be entered. The form 5 made available in this way is filled up with the aid of the writing instrument 30 according to the invention, which has a conventional writing device 45, for example a ballpoint pen refill cartridge or a graphite stick of a pencil. The form 5 is therefore available in a readable fashion without further aid, and can be evaluated conventionally and archived.

Moreover, the data written with the writing instrument 30 are recorded as described below. A device on the writing instrument records which magnetic field 25 the writing instrument is located over at a specific

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instant. For this purpose, the device comprises a coil (not illustrated) which detects the magnetic field strength of the individual fields 25 via the effect of induction. For example, if a specific field 25 is crossed, the relevant field is unambiguously recorded. By virtue of the fact that a simple piezoelectric element (not illustrated) picks up a certain pressure of the refill cartridge on the writing pad and supplies an electric voltage, in coordination with the voltage induced in the coil (not illustrated) by means of the magnetic field strength of the relevant field, a signal is available which can be used to infer the relevant crossed field unambiguously.

The signal produced by the coil is fed to the storage device in the writing instrument 30. Consequently, there is present in the storage device the information as to which fields have been crossed or, following therefrom, which fields have not been crossed. Furthermore, the fields can be set out in a very much finer array. In the same way as previously described, in the case of the finer, pixel-like array 26, not only is it recorded whether a field is crossed or marked, but it is possible to use the finer, pixel-like array 26 of the individual fields 25 to record the writing track which corresponds, for example, to a text written in block letters or script. It follows that the information of the written text, and the information on which field of the form 5 the text has been written are stored in the storage device of the writing device 30.

This renders it possible for the first time for a text written on the writing pad 10 described to be read off conventionally and, moreover, to be made available in the form of data without interposition of further devices.

The data of the writing operation which have been produced are transmitted terrestrially from the buffer via the transmitter 50 on the writing instrument to the antenna 60 of a receiver 70. The data, which are generally recorded in analog fashion, can

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advantageously be subjected to A/D conversion, in order to be able to make use of the advantages of the digital transmission, and to adapt them to digital systems which carry out further processing.

5 The receiver 70 comprises a computer with an associated database. The received data are further processed herein. The information on the form 5 in use and the crossed or marked fields are used to process the transmitted data further. It follows that the data
10 written down onto the writing pad in the receiver are present in real time, and that further operating steps, such as scanning in the filled-in form 5, are completely eliminated in the case of the invention. In particular, the data which are derived from the
15 recorded writing track on the finer, pixel-like array 26 are subjected to character recognition by applying an intelligent reading process to the data. The intelligent reading process is implemented in this case in the computer. As a result, the written text can be
20 read at a high recognition rate in block letters or even in script with the aid of suitable software or else by means of hard wired logic.

 The entire contents of the form 5, that is to say the contents of the pre-printed form together with
25 the assigned data which have been written down is therefore available in the memory of the computer which is assigned to the receiver 70. If, for example, the field in the pre-printed form is marked with "name", the name written down in this field is uniquely
30 assigned to this field in the computer. The recorded data can automatically be compared in an obvious way to the data present in the database, and the data can be updated automatically, if appropriate.

 Furthermore, in further operating steps a
35 signal can be transmitted from the receiver 70 to the transmitter 50 of the writing instrument if the form has evidently been wrongly filled in, for example a number has been written into the "name" field, or a field which is to be filled in without fail remains

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empty upon conclusion of the writing operation. This signal is displayed on the signalling device 35 of the writing instrument.

In the embodiment according to Figure 1, the writing instrument 30 records further physical quantities in addition to the data described above. If the writing instrument 30 records, for example, that there is writing in the "signature" formula field, it is possible to activate a sensor device (not illustrated) on the writing instrument 30, which records the quantities of speed, acceleration, pressure and inclination of the refill cartridge onto an arbitrary writing pad. The quantities of speed and acceleration are preferably determined by measurements on the surface of a trackball at the tip of the refill cartridge. The inclination of the writing instrument 30 during the writing of the signature can be determined with the aid of a micromechanical component. During the writing of the signature, not only does the piezoelectric element described above serve to produce a signal with the binary value as to whether the user is or is not exerting pressure on the writing pad 10 via the refill cartridge, but the pressure and the pressure difference are measured and recorded sensitively via the voltage transformed in the piezoelectric transducer.

These recorded quantities of the specific signature form, moreover, in combination with one another, a unique characteristic of the signature written down. The characteristic data are transmitted to the receiver 70 and, furthermore, compared in the computer with the data which are determined correspondingly from a reference signature of the relevant signer. The signature can be verified in this way. The verification is performed in certain tolerance ranges which result essentially from the sensitivity of the measuring devices used.

According to Figure 2, a particularly preferred embodiment of the invention includes a writing

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instrument 100 having three acceleration sensors 101a-101c, an inclination sensor 102 and a gyroscope 103. According to the invention, the acceleration sensors 101a-101c are used to record the acceleration of the writing instrument resulting from the production of a script and/or a drawing on the writing pad. The inclination sensor 102 is preferably constructed as a two-dimensional inclination sensor 102, which measures the inclination of the writing instrument 100 in absolute terms. In this case, an angle formed by the writing instrument 100 with reference to two axes is measured. The gyroscope 103 serves the purpose of determining the rotation, possibly occurring during the writing operation, of the writing instrument with reference to its longitudinal axis. The gyroscope 103 preferably includes sensors based on the piezoelectric effect.

According to the invention, use is made of an inclination sensor 102 which includes an electrolytic liquid and, in a roughly simplified fashion, measures an inclination angle using the principle of a spirit level. The rotation of the writing instrument with reference to its longitudinal axis is determined according to the invention by determining the angular speed. The angular speed is determined with the aid of a gyroscope 103, and the angle of rotations determined therefrom via integration with respect to time. According to the invention, use is made of a gyroscope 103 which can record a minimum rotation during the writing operation. It is necessary to be able to verify a rotation which is assumed during a writing operation of an individual word or of word parts by a rotation or shortening of the finger, gripping the writing instrument, of an otherwise fixedly positioned hand of a person doing the writing.

The acceleration picked up with the acceleration sensors 101a-101c is integrated twice with respect to time, and from this a determination is made of the path length covered on the writing pad during

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the recording of a script and/or a drawing. The starting point for being able to reproduce the script is the path length recorded from the two-fold temporal integration of the acceleration, the measured inclination of the writing instrument 100, and a rotation of the writing instrument about its longitudinal axis being included. In addition, the position of the writing instrument 100 relative to the writing pad is determined in absolute terms. The combination according to the invention of determination of relative position with determination of absolute position of the writing instrument 100 on the writing pad is performed progressively with time. In the process, the determination of relative position is preferably interrogated at a frequency of 300 Hz, whereas the detection of position for determining the absolute position is carried out, for example via the optical read-out of the bar code applied to the paper, at a substantially lower frequency, preferably approximately 10 Hz. This achieves according to the invention that the relative recognition of position is held within tolerable error limits between the recognitions of absolute position. In this case, it is preferable to fulfil the requirement that the relative position of the writing instrument, which is obtained from a temporal integration of the acceleration over a period of 2 seconds between two recognitions of absolute position, can deviate by a value of approximately less than or equal to 0.5 mm from the true course of the script.

According to the invention, the determination of the position of the writing instrument with reference to the writing pad is preferably performed via a uniform area coding. In this case, each coding element includes one bit sequence each for an x-coordinate, a y-coordinate and, in addition, a bit sequence which specifies the identifier for a specific form and, as the case may be, a page number thereof.

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The invention is not limited to the exemplary
embodiments described, which can be modified in
multifarious ways. Thus, it is evident that within the
scope of the present invention the measurement of the
5 relevant position, which is carried out during the
writing operation, can also be carried out otherwise
than with the aid of the devices described above. Thus,
it is conceivable to make a determination via an
optical evaluation of the pad, as is possible, for
10 example, in the case of the computer/mouse systems.
Again, it is also possible to use a trackball to
determine relative position. It is evident,
furthermore, that the said components can also be
replaced by micromechanical components, to the extent
15 that they have at least the same power and accuracy,
and these are inherent in the scope of the invention.

Finally and to conclude, it is evident that the
individual features of the invention can also be used
in combinations other than those illustrated and
20 described.

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